Microcalorimeters at High Energies

Assume HXT Requirements

FOV :	8 arc min
Angular Res:	< 1 arcmin
Focal length:	10 m

Focal plane scale: 2.9 mm = 1 arcmin

If we build another 30 x 30 microcalorimeter array (as per SXT requirement)

8 arc min	23 mm x 23 mm	0.77 mm pixels (samples HPD 3.8 times)

Current Demonstrated NTD Microcalorimeter Performance at 60 keV and 80 mK

50 eV 0.4 mm x 0.4mm x 25µm Sn absorber
60 eV 0.4 mm x 0.4mm x 25µm Pb absorber

If we increase pixel size from 0.44 mm to 0.77 mm and increase thickness 2 times
Volume increases by 8 times

$\Delta E \propto (T^2 C)^{1/2}$ ΔE increase by 2.8 x to **140 eV** !

Drop T to 60 mK from 80 mK back down to **80 eV**

Can we use Osmium?

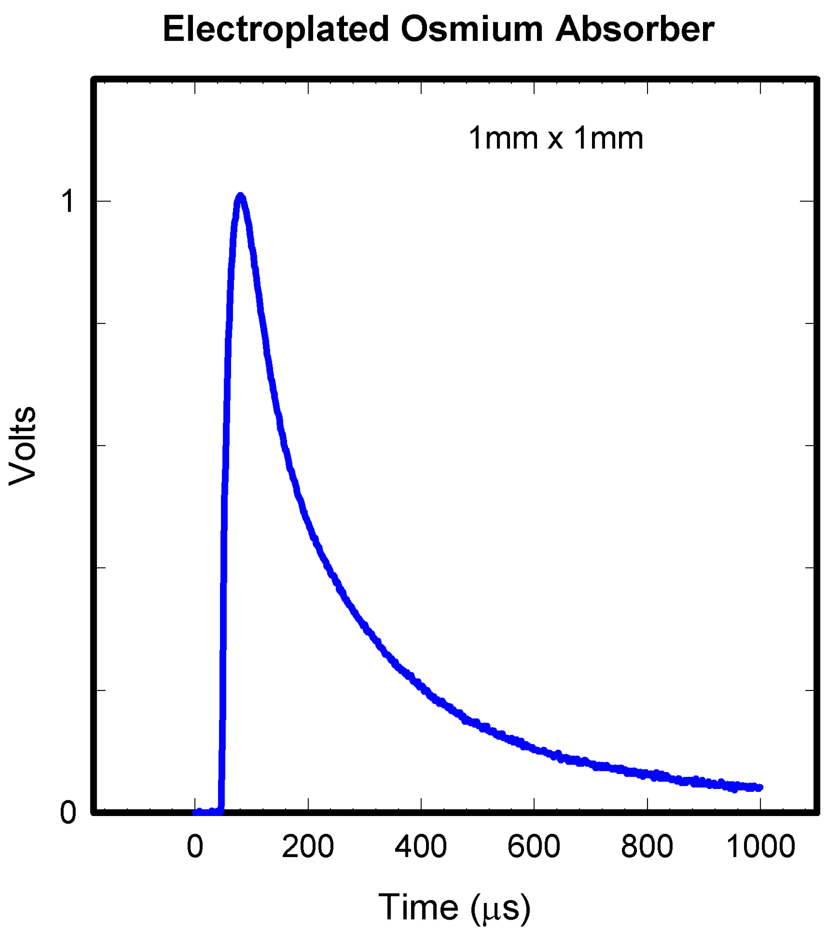
$Z = 76$
$T_c = 0.655$ K

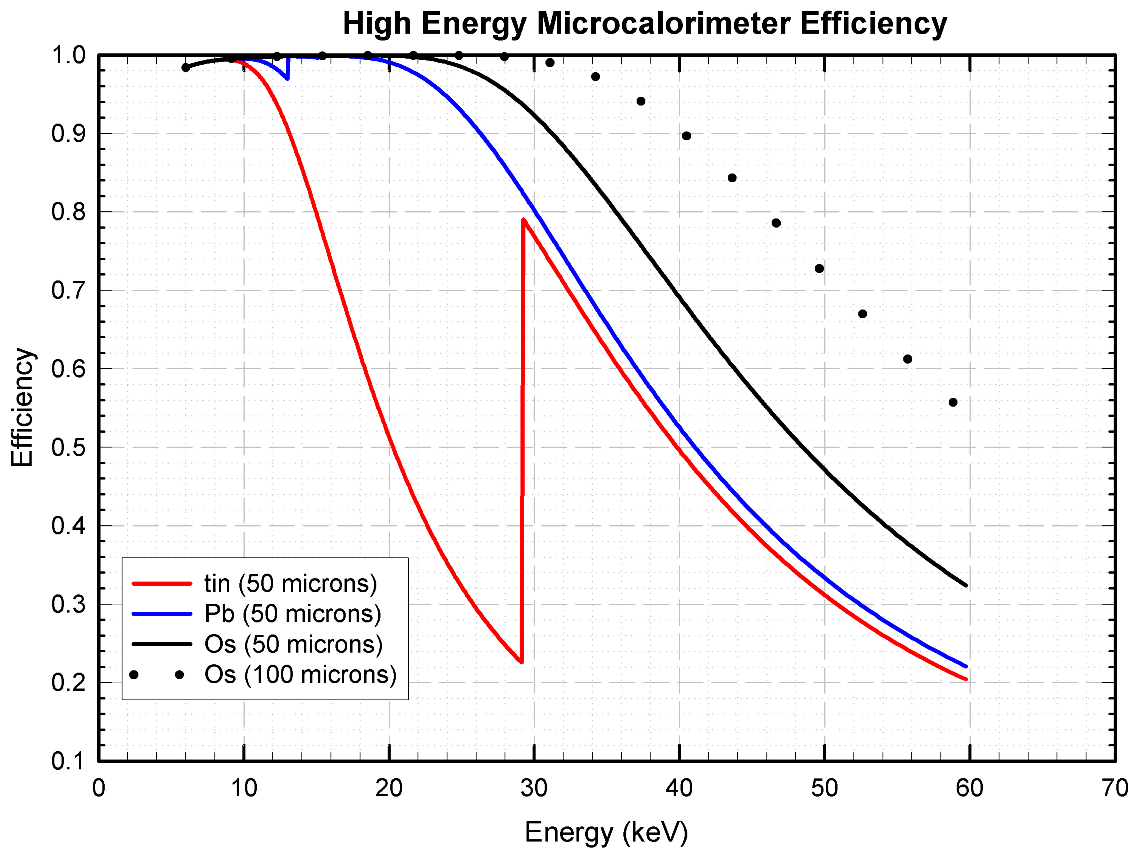
Θ_{Debye} (Os) = 500 (Θ_{Debye} (Sn) = 200)

C_v (Os) = C_v(Sn) / 15.6

So we could increase volume by 15.6 x and maintain performance

0.77 mm x 0.77mm x 100 μm





High Energy Microcalorimeter Efficiency
Efficiency
Energy (keV)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
60
70
tin (50 microns)
Pb (50 microns)
Os (50 microns)
Os (100 microns)

Status of NTD Microcalorimeter Development
February -April 2003

We can report that a prototype close-packed, 1 x 4 array has been built and will be tested shortly. It is shown in Figure 1. The plans for the next month include:

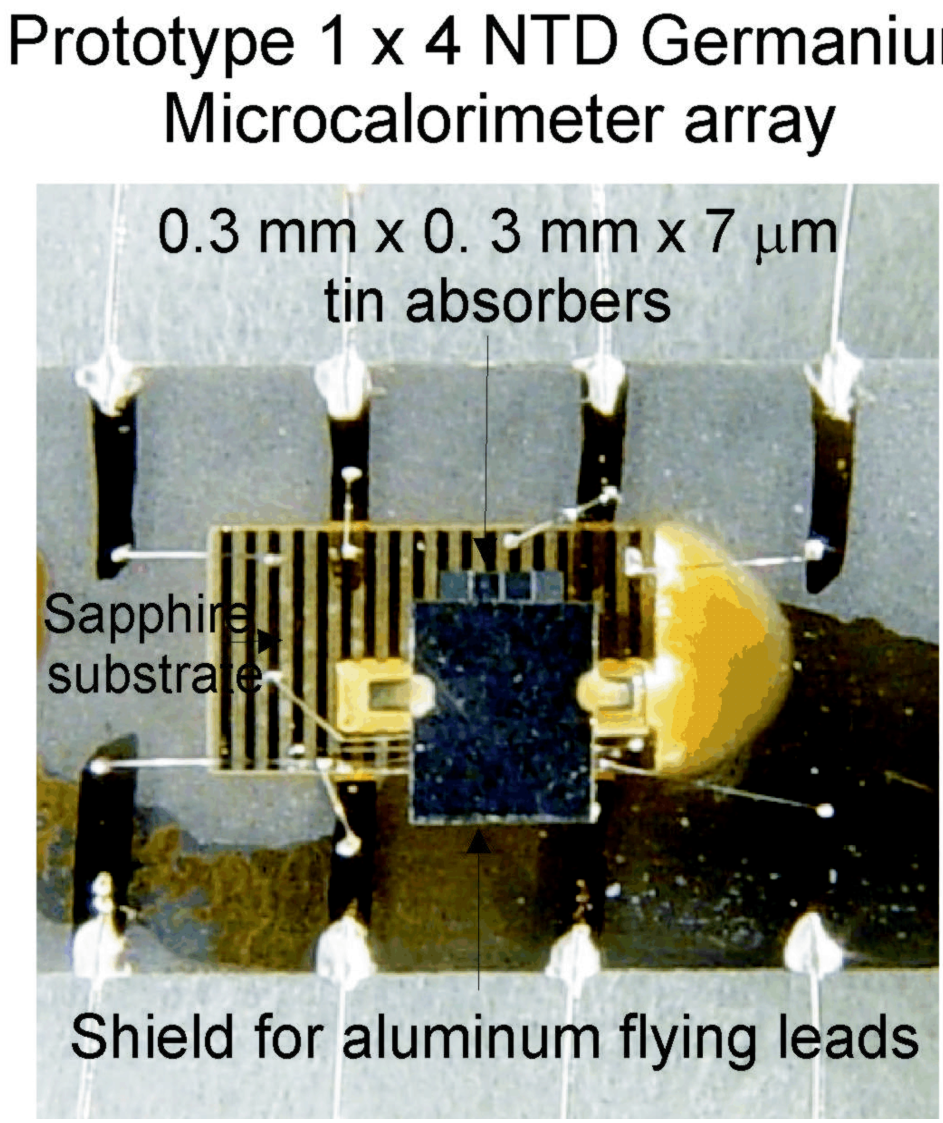


Figure 1. The prototype close-packed, 1 x 4 NTD Ge array.

1. Testing the 1 x 4 array

2. Testing New Absorber Materials

a. Tin 99.75 % purity;. The main impurities are Cr, Cu and Fe where both Cr and Fe are ferromagnetic. This property may contribute to the creation of sub-gap areas that may speed-up the energy transfer from QP to phonons.

b. Tin 97.4 % purity. The main contamination is 2.4 % of Sb that may prevent Tin from undergoing the crystal structure transition from tetragonal to cubic structure occurring at 13 degrees C . The pure tin we have used to date has a cubic structure at low temperature and remains tetragonal. Whether this different crystal structure affects the timescale of the thermalization process is not known and is probably worth testing.

c. Pb(90%) / Bi(10%). This material should be much faster than tin in converting energy from the QP system to the phonon system.

d. We would like to use an absorber of pure Tin with a layer of Cu on top. Although we tried this before, we have not have taken care to clean the natural layer of oxide in Tin before depositing the Cu layer. The oxide will prevent the QP from moving back and forth from the bulk absorber to the sub-gap superconductor layer (Cu will be superconductor via the proximity effect).